

SCAG Maglev Task Force

Concrete Magway

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1. "Magway" is like "railway".

1

Topics

- About PCA
- California's Concrete Industry
- SCAG Maglev IOS
- Construction Methods
- Examples of Concrete Bridges
- Concrete Magways

2

Portland Cement Association

- Non-profit trade association
 - Founded in 1916
 - Improve & expand the use of concrete
 - Represents 97% of US manufacturers
 - 10 companies in California
- Skokie, IL & Washington, D.C.

1. The Portland Cement Association is active in manufacturing, in raising the quality of construction, in improving portland cement and its uses, and in contributing to a better environment.
2. PCA has well-rounded programs of market development, education, research, technical services, and government affairs on behalf of PCA members-cement companies in the United States and Canada.
3. PCA offices are located in Skokie, Illinois and Washington, D.C. with regional engineering managers located in California, Minnesota, New Jersey, Virginia and several other states.

3

Concrete



1. In addition, admixtures such as fly ash, silica fume, and blast furnace slag are added to enhance the properties of concrete.
2. Also, chemicals may be added to improve placing characteristics, and to retard or accelerate curing.
3. Most concrete is also reinforced with steel reinforcing bars.

4

The Concrete Industry

- ▶ Portland Cement
- ▶ Sand & crushed stone
- ▶ Steel reinforcing bars
- ▶ Ready mixed concrete
- ▶ Concrete contractors
- ▶ Precast/prestressed concrete

1. The concrete industry is made up of the separate segments shown on this slide.
2. PCA member companies may own in sand and crushed stone and ready mixed concrete subsidiaries.

5

California Concrete Industry

Attribute	Number
Direct employment	127,000
Cement plants	10
Ready mixed concrete plants	483
Other concrete plants	294
Concrete contractors	3,260

1. Other concrete plants produce precast, precast/prestressed, concrete block, concrete brick, and concrete pavers.
2. Since the Los Angeles area contains about 1/3 the population of California, divide the numbers in the chart by three to obtain the numbers in the LA area.

6

California Concrete Industry

Attribute	Amount per Year
Value of concrete construction	\$12 Billion
Concrete industry payroll	\$5 Billion

7

California Concrete Industry & IOS

Attribute	Number per Year
Concrete for SCAG IOS	¼ million cubic yards
2006 Ready mixed concrete production	50 million cubic yards
Cement for SCAG IOS	70,000 tons
2006 Cement production	14 million tons

1. Quantities for SCAG IOS considering concrete construction occurs over a 4 year period.

8

SCAG Maglev IOS

Maglev Concept



9

10

Maglev Concept



1. This slide shows the recreational improvements that could be built along the Magway.

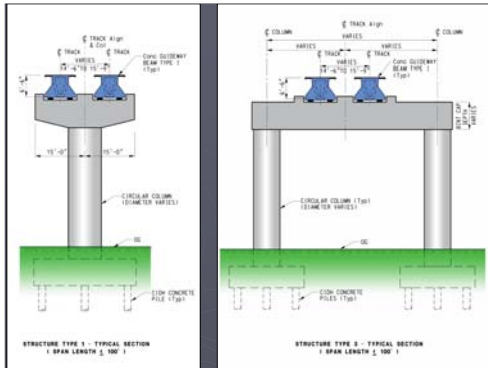
Objectives for Use of Highway Right of Way

- ▶ Provide a Functional System
- ▶ Minimize the Cost of New Real Estate
- ▶ Promote Rapid Construction
- ▶ Build Aesthetic Structures
- ▶ Maintain Highway Traffic



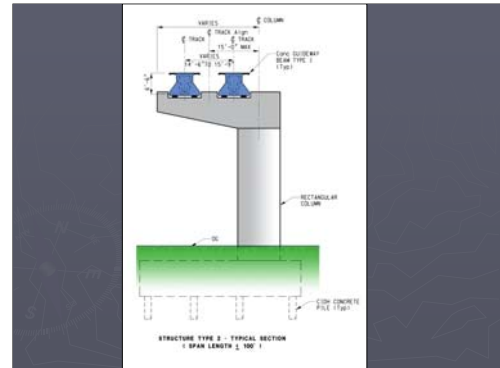
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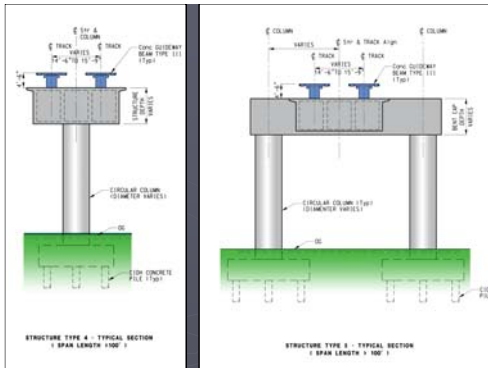
1. For spans less than 100' precast/prestressed concrete beams will be supported on a single pier or straddle pier depending on the site conditions.

13



1. For spans less than 100' precast/prestressed concrete beams can be supported on an offset pier if required by site conditions.

14



1. For spans greater than 100' precast segmental concrete beams will be supported on a single pier or straddle pier depending on the site conditions.
2. The beam in turn will support the precast concrete guideway.

15



1. The following slides show transit system construction because similar concepts can be used for Magway construction.

16

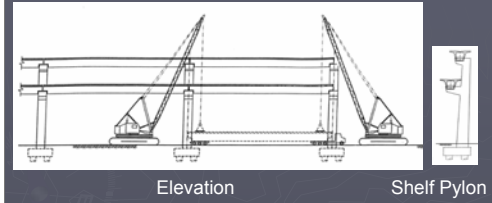
Washington, D.C. Metro Shared Corridor Perspective



1. Washington D.C. Metro is planning to use the Interstate right of way for expansion of the Metro.
2. Because there is not enough space for a double track at grade, aerial structures are required.
3. The spans could range from 80' to 130'.
4. For side by side dual track, the required width is 31'.
5. Shelf pylons are used where there is not enough space for side by side tracks.

17

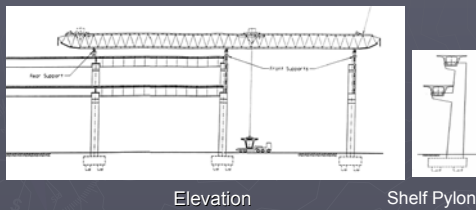
Prestressed Girder Erection



1. This slide shows a precast/prestressed concrete beam being lifted into position on the shelf pylon after being delivered by a truck.

18

Segmental Girder Erection



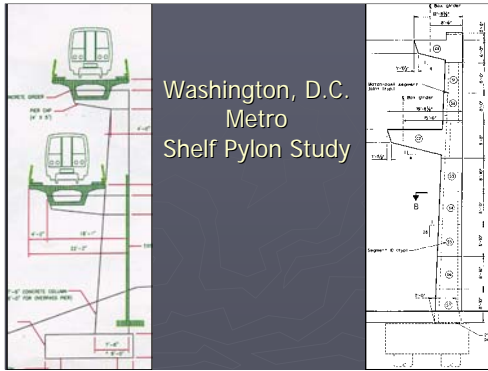
1. This slide shows a precast concrete segment being lifted into position after being delivered by a truck.
2. The segments are hung from the erection truss until the entire beam is complete.
3. After the segments are all in place the beam strong cables are pulled through ducts in the beam and post tensioned.

19

Girder Comparison

	Segmental Girder	Prestressed Girder
Maximum Span	500'	170'
Weight	40 tons/Segment	80 to 170 tons
Fabrication	Precast Plant or Contractor Plant	Prestressed Plant

20



1. This slide shows a shelf pylon at an intersecting road where the height of the pylon is 78'.
2. The drawing on the right shows the segment layout.
3. After all the segments are in place they are post tensioned with strong cables.

21

Pylon Comparison

	Cast-in-Place	Segmental
Time to Construct	Several Days	1 Day

22

Erection of Segmental Pier



23

JFK AirTrain Port Authority of NY & NJ



1. The JFK Airtrain runs down the Van Wick Expressway in New York.
2. The aerial structure is 8.7 miles long.
3. Spans are 80-150 feet
4. The dual track are placed side by side with a total width of 31'.
5. The piers were cast-in-place.
6. The precast segmental beams required 1.5 day per span.

24

JFK Airtrain Project New York



1. The JFK Airtrain aerial structure used segments which were 7' deep x 9' long.
2. A total of 5,195 segments were produced for the project.
3. 12 segments/day were cast in a plant in Virginia and shipped on barge to New Jersey and then transported on trucks to the construction site.
4. The segments on this project were supported on the erection truss until they were post tensioned.

25

Construction of JFK AirTrain



1. This view shows the aerial structure under construction and the space required for the erection crane.
2. Notice that traffic continued to use the roadway.

26

Selmon Crosstown Expressway Tampa, Florida



1. precast segmental construction was used to build the Selmon Crosstown Expressway Reversible Traffic Lanes
2. This project used 142' spans and sculptured shapes & feature lighting.

27

What Is Best?

- Owner's Bid Documents
 - Structural & aesthetic criteria
 - Work zone limitations
 - Maintenance of traffic
 - Incentives to meet the schedule

1. The owner's bid documents should address the structural & aesthetic criteria, work zone limitations, maintenance of traffic, and incentives to meet the schedule.

28

Examples of Concrete Bridges

29

Port of Miami Bridge
Miami, Florida



1. Lighting adds interest to bridge structures at night.
2. Notice the curved columns and vertical lines on the columns.

30

Merrill Barber Bridge
Vero Beach, Florida



31

2002 Big I Interchange
Albuquerque, NM



1. Precast/prestressed concrete bulb tees with 150' maximum span along with precast segmental construction were used to build 45 new bridges for the large interchange.
2. The interchange was constructed in 24 months.
3. Color stain was used to match the surrounding area and to give a uniform appearance.
4. The repeated use of simple shapes and streamlined girders are appealing.

32

Pine Valley Creek Bridge 1974 San Diego, California



- Cast-in-Place Segmental
- Maximum Span 450'

1. The first U.S. cast-in-place balanced cantilever segmental bridge was the monumental Pine Valley Creek Bridge near San Diego, completed in 1974.

33

I-75/I595 Interchange Broward County, Florida



- Precast Segmental Balanced Cantilever
- 148' Spans

1. The I-75/I-595 Interchange in Broward County Florida incorporates 14 precast balanced cantilever segmental bridges with average spans of 148 ft.
2. Segments were cast at the on-site casting yard simultaneously with earthwork and sub-structure work. The interchange was completed one month ahead of schedule.

34

I-15/U.S.95 Spaghetti Bowl Aug. 2000 Las Vegas, Nevada



1. Precast span-by-span segmental construction was used to build 11 new bridges for this interchange
2. The total area of the bridges was 253,313 sq ft and the total length of bridges was 1.4 miles.

35₂

Spaghetti Bowl - Erection



1. The construction method was selected to minimize traffic disruption and reduce the quantity of on-site materials.
2. One span per week was completed
3. The construction procedure was as follows:
 - Construct Column and Set Pier Segment
 - Launch Span by Span Overhead Gantry
 - Place Segments (10 Segments Typical)
 - Epoxy Joint and Temporary Post Tension
 - Install closure pour
 - Install final post tensioning

36₈

Spaghetti Bowl - Traffic Impacts



1. The traffic was detoured if the gantry pier support beam is moved over traffic.
2. The traffic was detoured while segments were moved.
3. Traffic was permitted under the span for temporary post tensioning, closure pour, and final post tensioning work.

37

Skytrain Project, Vancouver, BC, Canada



1. This slide show the Skytrain Project in Vancouver, B.C.
2. Segments are hung from the truss until final post tensioning.

38

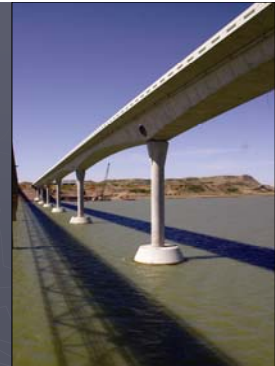
I-40 Overpass Guadalupe County, NM



1. Southwestern style art welcomes drivers to Guadalupe County and New Mexico.
2. Four precast 54" deep U beams were used for the superstructure.
3. Spans are 105' -8" and form liners were used to create the art.

39

Four Bears Bridge Lake Sakakawea North Dakota



1. The 4500' long bridge was built using precast segmental construction with 316' spans.
2. Included in the design is local Indian culture symbols.
3. Precast concrete segmental construction was selected because of its durability, low maintenance, speed of construction, and low initial cost.

40

Perry Street Bridge - Napoleon, Ohio



1. Precast/prestressed concrete was used to simulate the original bridge which was built using cast in place construction.
2. The new bridge was constructed in a total of 9 months.

41

Elbe River Water Bridge, Germany



1. This is the most unusual bridge I have seen. The bridge, completed in 2003 cost 500 million euros and took six years to construct.
2. The large concrete bathtub is 918 meters long, contains 24,000 metric tons of rebar, and 68,000 cubic meters of concrete.

42

Concrete Magways

- ▶ TVE Test Facility – Emsland, Germany
- ▶ Shanghai, China

Structure Requirements

- ▶ Accurate fabrication and erection
- ▶ High vertical and lateral stiffness
- ▶ Long term dimensional stability
- ▶ Low thermal expansion
- ▶ 75 to 100 year life
- ▶ Low maintenance
- ▶ Low life cycle cost



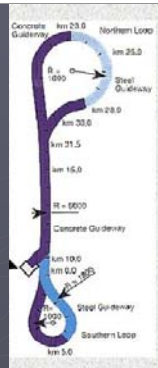
The Maglev aerial structure has demanding requirements. The modular components must be built to accurate fabrication and erection tolerances. Stator packs, part of the functional components, are built in approximately one meter lengths. Normal deflections that are caused by the load of the Maglev vehicles and changes in ambient temperature must be sufficiently small to maintain a comfortable ride for passengers at 310 mph. Vertical deflections under the load of the Maglev vehicle must be limited to $\frac{1}{4}$ " and the vertical deflection under temperature changes must be limited to $\frac{3}{16}$ " for girders with a span of 31 m (102'). Long life and long term stability are also necessary for the Maglev guideway. The design service life of the structure is required to be 80 years. Of course, to make Maglev economically feasible, the guideway initial construction cost and annual maintenance cost should be as low as reasonably possible.

43

44

TVE Test Facility

- ▶ Emsland, Germany
- ▶ Opened Jan 1, 1985
- ▶ 19.6 miles long
- ▶ 13 miles of concrete girders
- ▶ 6 miles of steel girders



1. The most important example of the use of concrete girders is Transrapid's own experience at the TVE-Test Facility.
2. The test track is 31.5 km long and 2/3 of all the girders are constructed of concrete.

45

TVE-Test Facility



1. The test track was built to the very tight tolerances required by Maglev and became operational on January 1, 1985.
2. Problems with stator attachments experienced in the initial use of the test facility were solved.
3. Although provision for adjustment of 20 mm was built into the beam bearings, no adjustments have been required after 20 years of operation.
4. The concrete girders were built to the required tolerances in a specially constructed fabricating plant.

46

Shanghai Precast/Prestressed Concrete Plant



1. A new plant was constructed to manufacture the concrete beams for the Shanghai Maglev.

47

Precast/Prestressed Plant



1. Up to 12 girders a day were produced by the plant.

48

Cast-in-Place Substructure Construction



1. The piers were built using cast-in-place construction.
2. On the left use is shown the formed piers and rebar cages in the background.
3. On the left is the completed pier.

49

Beam Erection Using Gantry Cranes



1. This picture shows the 81.8' concrete girders being transported and erected for the 19 mile Shanghai Maglev project.

50

Beam Erection Using Gantry Cranes



1. This is another view of the beam erection by gantry cranes.

51

Beam Erection Using Crawler Crane



52

Completed Guideway Structure



53

Completed Vehicle



1. The new vehicle is moved out of the maintenance facility.

54

Concrete Magway

- ▶ Proven Material
- ▶ Long Life
- ▶ Low Maintenance
- ▶ Lowest Life Cycle Cost



Concrete Magway Alliance

1. Concrete is a proven material and is used for 70% of the highway bridges built since 1990.
2. The use of high performance concrete will allow the structure to last 100 years.
3. Concrete structures used in transportation facilities have an excellent record of low maintenance.
4. The initial construction cost and life cycle cost of concrete aerial structures are lower than for any other material.

55